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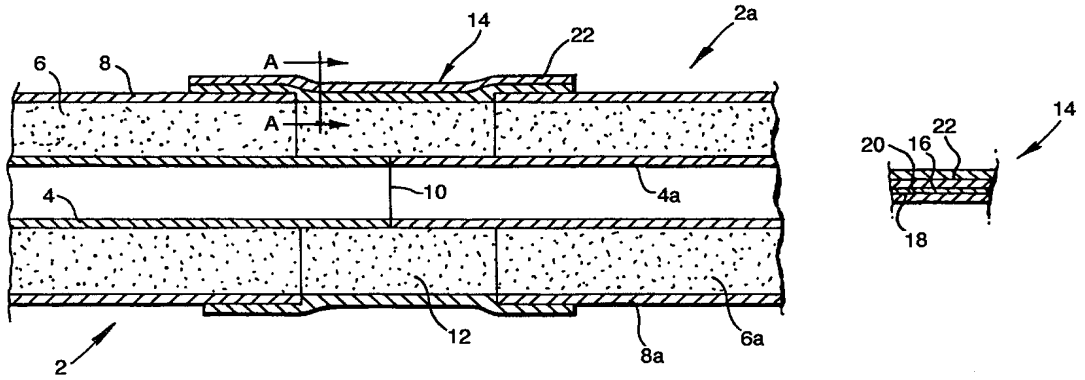

(57) Abstract

A method of protecting a metal pipe against environmental corrosion by applying a covering thereto, wherein the covering comprises an inner layer for forming a bond with the pipe, an outer organic layer, and an intermediate layer, fully enclosed by the inner and outer layers, that is substantially impervious to the transmission of moisture vapour.

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PIPE CORROSION PROTECTION

This invention relates to the protection of a metal pipe against environmental corrosion, and is particularly concerned with the application of a corrosion protection covering to the pipe.

Metal pipes are frequently used to carry water, oil, or gas, for example, either at ambient or at elevated temperature. In many instances, such pipes are buried in the earth or are laid on the sea bed, and as such are exposed to a hostile environment from which they need to be protected, especially from corrosion. This is usually done by one of two methods. In the first method, a pipeline, of steel for example, is coated with an organic material, such as polyethylene, polypropylene, an epoxy, coal tar or urethane that is bonded to the pipe by an adhesive. Such material provides a barrier to the penetration of water, and operates on the principal that by sealing the steel surface from the external environment, i.e. the soil or water, the amount of water and/or oxygen penetrating through the organic coating will be reduced to such a small amount that corrosion will be limited, thereby providing the pipeline with a reasonable, economic lifetime. In the second method, a coating of a different metal is applied in direct contact with the steel, to act as a sacrificial electrode which will preferentially slowly dissolve away so as to allow the pipeline to have a useful life of, say, 20 years. In practice, such sacrificial anode protection systems are used only with ductile iron pipes, not steel, and only in environments where the soil is known not to be aggressively corrosive.

We have now discovered from inspection of pipes coated with organic materials, that after several years operation water has penetrated through the protective coating and reached the steel surface in larger amounts than known moisture vapour transmission rates would suggest. Although the amount of water, initially, is not enough to cause severe corrosive effects, it is found that its presence is sufficient to destroy the bond between the organic coating and the metal pipe. Under these conditions, more water is able to penetrate through to the pipe and thus to cause further and more serious damage. Water penetration occurs apparently due to osmosis, and is exacerbated when a cathodic protection system is applied, as is common, to a pipeline. The flow of current to the pipe that is characteristic of cathodic protection has been found to act as a 'pump' so as actually to urge moisture towards the pipe through the bond line. Furthermore, under certain circumstances, even small amounts of

corrosion can lead to stress cracking of the metal, which can lead to catastrophic results in that small cracks can suddenly split the pipe open, releasing its contents, which may be gas or oil, and can thus lead to an explosion.

It is one object of the present invention having recognised the aforementioned problems, to provide environmental protective covering of a metal pipe in a simple manner and that is substantially impervious to water or moisture vapour.

In accordance with one aspect of the present invention, there is provided a method of protecting a metal pipe against environmental corrosion by applying a covering thereto, wherein the covering comprises an inner layer for forming a bond with the pipe, an outer organic layer, and an intermediate layer that is fully enclosed by the inner and outer layers and that is substantially impervious to the transmission of moisture vapour.

It will thus be appreciated that the water penetration through the pipe coating, whether due to known moisture vapour transmission or to the aforementioned osmosis, is substantially reduced or eliminated by the provision of the impervious layer. Furthermore, the moisture vapour layer, being sandwiched between the inner bonding layer and the outer organic layer, itself is not required to form a bond to the pipe, and furthermore, is protected from external corrosive effects by the outer mechanical protection layer.

It will be appreciated that the method of the invention provides corrosion protection for pipes of steel, iron, or other metal, and when such pipes are enclosed within most types of environment, including aggressive soil and the sea. Thus, the integrity of the bonding interface between the covering and the metal pipe is maintained under these conditions.

The intermediate layer preferably comprises a metal, and may conveniently be provided as a foil, and is preferably aluminium.

The inner layer will normally comprise an adhesive or a mastic, depending upon the material of the pipe.

Advantageously the outer layer is polymeric, and preferably formed from high density polyethylene. Further mechanical reinforcement of the covering can be provided by loading the outer layer with fibres.

It is envisaged that the covering of the invention may be applied to a pipe that already has a coating thereon, for example as a primer layer and or a thermally insulating layer.

The covering of the pipe may be provided as a tubular or wraparound sleeve, or in the form of a tape, and may be applied to the pipe in situ or during its manufacture. It is

also envisaged, however, that the covering may be applied during manufacture of the pipe, by single or multi layer extrusion techniques for example.

Particularly, though not exclusively, the covering may be applied in the field to a joint region between two lengths of pipe. It will be appreciated that to form a joint, usually by welding, any coating, including insulation, has to be cut back to expose the metal. After the two lengths of metal pipe have been welded together, insulation is applied thereto, for example by foaming polyurethane therearound, and a corrosion-protection covering applied thereto in accordance with the invention.

Advantageously, the pipe covering is formed as heat recoverable component, for example by providing the outer layer as a heat recoverable polymer, and the application of heat to recover the covering around the pipe can then also activate the inner layer, for example of hot-melt adhesive, and form the bond to the metal pipe.

In accordance with another aspect of the present invention, there is provided a metal pipe having applied thereto a covering that comprises an inner layer forming a bond thereto, an outer organic layer, and an intermediate layer that is fully enclosed by the inner and outer layers and that is substantially impervious to the transmission of moisture vapour.

The pipe covering of this other aspect of the invention, and its method of application may be as set out above.

Heat recoverable fibre/fabric polymeric sleeves having an inner adhesive layer and enclosing a metal foil, are known for providing mechanical protection, electrical screening and environmental sealing of cables. EP-B-0 443 696 (NV Raychem SA), for example, discloses such an article, in particular one having an outer polymeric layer and an intermediate strengthening layer, preferably comprising a metal foil, that acts inter alia as a barrier to moisture vapour transmission. Hitherto, however, such articles have been used for sealing a joint between telecommunication or electrical power cables, the object being to prevent water from entering through the joint and causing cross talk or electrical short circuits. In contrast, the present invention is concerned with the preservation of an adhesive bond line at a metal pipe that is subject to a corrosive environment. Furthermore ingress of moisture to the pipe surface can actually be exacerbated by arrangements, such as cathodic protection, that are specifically employed in order to provide environmental protection for the pipe.

An insulated pipeline protected in accordance with the present invention will now be described, by way of example, with reference to accompanying drawing, in which:

Figure 1 is a sectional elevation of the covered pipeline; and

Figure 2 is a section along the line A-A of Figure 1.

Referring to the Figures, a first pipe 2 for carrying hot water comprises an inner steel pipe 4 of diameter 15 cm that is enclosed within a 5 cm thickness of thermally-insulating polyurethane foam 6 and an outer polyethylene jacket 8 of wall thickness 14 mm. At its end, the steel pipe 4 projects beyond the outer components of the pipe 2 and is welded at 10 to a further length of similar pipe identified by corresponding numerals having the subscript 'a'.

The region around the weld 10 and between the adjacent faces 6, 6a of the pipe insulation and 8, 8a of the outer jacket now has to be provided with thermal insulation and environmental protection. The insulation is provided by polyurethane foam 12 that is expanded in situ, and the environmental protection is provided by a covering 14, exemplifying the present invention, that extends longitudinally so as to cover the foam 12 and overlap at each side on to the pipe jackets 8, 8a.

Referring in particular to Figure 2, the covering 14 has an outer heat recoverable high density polyethylene wraparound sleeve 16, an inner hot melt layer 18 and, sandwiched therebetween, an intermediate layer 20 of aluminium foil of thickness x mm. Each longitudinal edge of the polymer sheet 16 is provided with a thickened rail, and these are brought together and secured by a stainless steel channel 22 after the covering 14 has been wrapped around the joint region of the pipes 2, 2a. Heat is then applied to the covering 14 to cause the outer sleeve 16 to recover and to drive its inner components radially inwards into conformity with the substrate and to cause the adhesive 18 to bond to the pipe jackets 8, 8a and to the insulation 12.

The pipeline thus jointed is both insulated and environmentally protected. It is seen that the amount of thermal insulation is the same across the joint region as along the length of each pipe section, but that the thickness of the pipe jackets 8, 8a, which provide a barrier to the transmission of moisture vapour over the length of the pipes, is replaced in the joint region by a significantly thinner layer of polyethylene 16, typically of 2 or 3 mm thickness, and the metal foil 20, typically much thinner than 0.25 mm, acting as a barrier to the transmission of moisture vapour.

It will be appreciated that where the pipeline is not insulated, the covering 14 would be brought into direct contact with the metal pipe, or with a primer coating layer thereon. Furthermore, the covering may be provided by a tubular sleeve that is parked on one of the pipes prior to the weld being made and is then moved into position to provide the required protection of the vulnerable joint region.

Claims:

1. A method of protecting a metal pipe against environmental corrosion by applying a covering thereto, wherein the covering comprises an inner layer for forming a bond with the pipe, an outer organic layer, and an intermediate layer, fully enclosed by the inner and outer layers, that is substantially impervious to the transmission of moisture vapour.

2. A method according to claim 1, wherein the intermediate layer comprises a metal foil, preferably of aluminium.

3. A method according to claim 1 or claim 2, wherein the inner layer comprises an adhesive or mastic.

4. A method according to any one of the preceding claims, wherein the outer layer comprises a polymeric material.

5. A method according to any one of the preceding claims wherein the outer material is reinforced with fibres.

6. A method according to any one of the preceding claims, wherein the metal pipe has a coating thereon, and wherein the bond between the covering and the pipe is formed with the coating of the pipe.

7. A method according to claim 6 wherein the pipe coating comprises a primer layer and/or a thermally insulating layer.

8. A method according to any one of the preceding claims, wherein the covering is applied to a joint region between two lengths of pipe.

9. A method according to any one of the preceding claims, wherein the covering is applied as a tubular sleeve, as a wraparound sleeve, or as a tape winding.

10. A method according to any of the preceding claims, wherein the covering is heat-recoverable and wherein heat supplied to effect the recovery around the pipe also effects the bonding to the pipe.

11. A method according to any of the preceding claims, wherein a cathodic protection arrangement is applied to the pipe to enhance the environmental protection thereof.

12. A method according to any one of the preceding claims, wherein the covering is applied to a joint region between two lengths of pipe.

13. A method of protecting a metal pipe against environmental corrosion by applying a covering thereto, substantially as hereinbefore described with reference to the accompanying drawing.

14. A metal pipe having a corrosion protection covering applied thereto in accordance with any one of the preceding claims.

15. A corrosion protected metal pipe substantially as hereinbefore described with reference to the accompanying drawing.

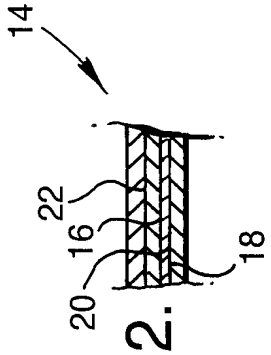

Fig.2.

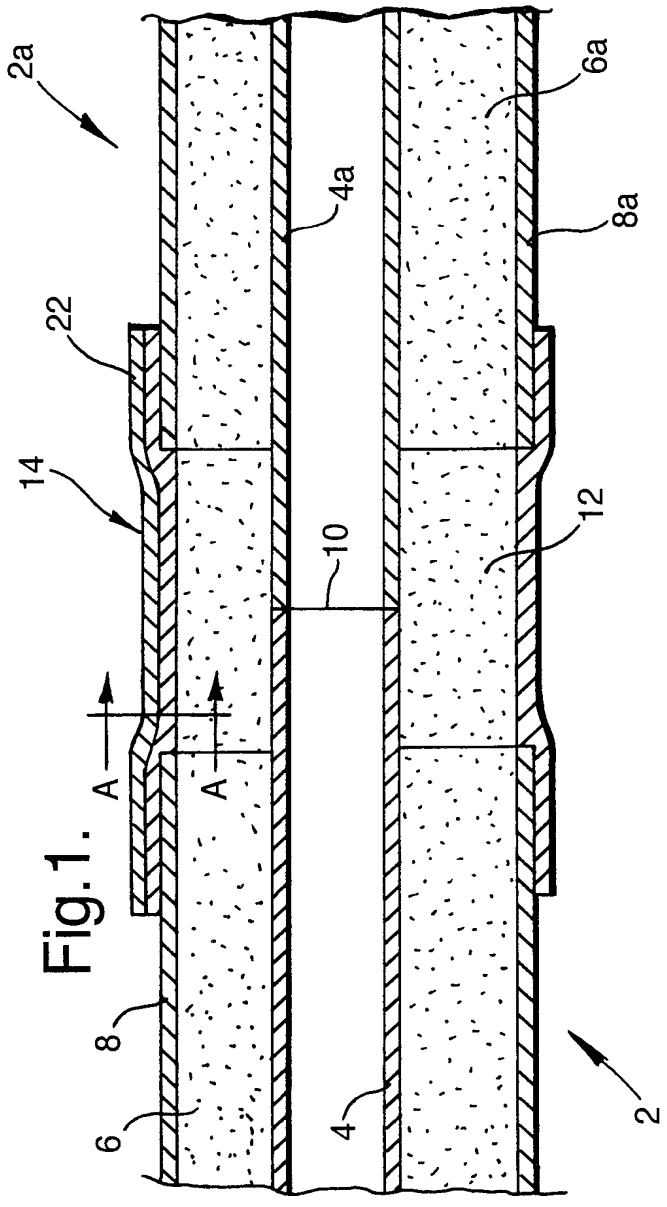

Fig.1.

INTERNATIONAL SEARCH REPORT

Int onal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16L58/04 B29C61/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16L B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 317 356 A (COURTAULDS COATINGS) 25 March 1998 see page 8, line 17 - page 9, line 16	1-4,8,9
X	EP 0 443 696 A (RAYCHEM SA NV) 28 August 1991 cited in the application see page 3, line 5 - page 3, line 28; figures 1,2	1-5,9, 10,14
X	US 4 241 121 A (O'CONNOR LAWRENCE) 23 December 1980 see claim 3; figures 1,2	1,2,4,6, 7,14
X	EP 0 380 929 A (KAISER KABEL GMBH) 8 August 1990 see column 2, line 53 - column 3, line 7; figures 1,2	1-4

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[X] Further documents are listed in the continuation of box C.

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